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More Fruits, Veggies, Cereal Reduce Risk

Eating more fruits, vegetables and cold cereal fortified with folic acid—a form of folate—should significantly reduce the risk of heart disease and stroke that comes from having high blood levels of homocysteine, a new study shows. These foods contribute the most dietary folate, which the body needs to convert homocysteine into a nontoxic amino acid and thus prevent damage to blood vessels.

Researchers found an unusually strong relationship between the amount of these foods consumed and blood levels of folate and homocysteine in a study of 855 elderly men and women participating in the Framingham Heart Study. And that's after adjusting the data for age, gender, total calorie intake and the use of supplements containing folate.

Study subjects who ate at least five to six servings of fruits and vegetables daily had the highest blood folate levels and the lowest homocysteine levels, as did those who averaged nearly one serving of breakfast cereal daily. Those who ate less than three servings of fruits and vegetables daily and seldom ate cereal had the highest homocysteine levels, the researchers reported in the *Journal of Nutrition* (vol. 126, pp. 3025-31). Orange juice and dark green leafy vegetables, such as broccoli and spinach, were the major contributors of folate among the fruits and vegetables.

The study also found that women's homocysteine levels were lower than men's. And subjects aged 67 to 80 had lower levels than those over 80, despite higher blood folate levels in the latter group. Supplement users had the lowest homocysteine levels, but not much lower than frequent consumers of fruits, vegetables and cereal. This suggests that people of all ages can reduce their health risk substantially simply by changing their diet. That's especially important for the elderly, who tend to have low folate status.

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Carotenoids Show Their True Colors

Daily servings of dark green and deep yellow vegetables and tomatoes boost immune response, a preliminary study suggests. If the findings hold up in further research, eating more vegetables rich in beta carotene and related carotenoids—lutein and lycopene—may help people ward off a cold or flu as well as protect against cancer.

The researchers wanted to know if people could increase their blood levels of these carotenoids—the red, yellow and orange pigments in fruits and vegetables—by eating acceptable portions of carotenoid-rich vegetables. So 12 volunteers lunched daily on five servings of cooked kale and sweet potato and washed it down with tomato juice—together providing 10 times more than typical U.S. carotenoid intakes. After three weeks, the volunteers had a 33 percent increase in immune response as measured by the ability of their T cells to multiply. This is a good measure of immune system function because T cells play a vital role in the immune response to foreign organisms and cancer cells.

The veggie lunches also more than doubled blood levels of beta carotene and increased lutein by 67 percent and lycopene by 26 percent. Sweet potato is rich in beta carotene, while kale and tomato are top sources of lutein and lycopene, respectively. As potent antioxidants, these carotenoids are thought to contribute to the lower rates of heart disease, cancer and other diseases of aging among populations that eat a lot of fruits and vegetables.

Reported in the *Proceedings of the UJNR Protein Resources Panel, 25th Annual Meeting, 1996,* the findings suggest that carotenoid-rich vegetables also stimulate the immune system. But other tests done during the study failed to show any reduction in oxidation of blood lipids or damage to DNA molecules.

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Other new findings about the thyroid and oxidation could bring researchers closer to answering the question: Do carotenoids warrant a Recommended Dietary Allowance? Two experiments with female volunteers examined the effects of meals low in carotenoids. The experiments—one lasting 14 weeks and the other 17 weeks—were the longest and most rigidly controlled low-carotene studies using

human volunteers. Each study had about a dozen participants.

Thyroxine, a key thyroid hormone, increased when the women ate few carotenes or other carotenoids at mealtimes. This finding, reported in the *Journal of Nutritional Biochemistry* (vol. 6, pp. 613-617), adds to the few previously known links between carotenes and the thyroid.

Researchers also found more evidence suggesting carotenes act as antioxidants to protect the body from harmful oxidation that could contribute to heart attack, stroke and cancer. During the low-carotene stints, researchers recorded several biochemical signs of oxidative damage. For example, they found more carbonyl compounds—breakdown products of oxidation—in the volunteers' blood and breath. This was reported in the *Journal of the American College of Nutrition* (vol. 15, pp. 469-474).

The scientists apparently were the first to note these changes in humans in a carotenoid study that featured familiar foods. Later experiments elsewhere found similar results. Further ARS studies will try to shed more light on whether a specific minimum daily intake of carotenoids is important for good health.

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Beta Carotene Boosts Immunity in Elders

Older people who get plenty of beta carotene may have a better chance of preventing virus infections or a cancerous growth. A wealth of epidemiological evidence has linked a high intake of green leafy and deep yellow vegetables—both rich in beta carotene—with lower rates of many types of cancer. But recent studies found a higher rate of lung cancer in smokers who took beta carotene supplements. And the supplements did not meet expectations for reducing cancer incidence in the 12-year-long Physicians Health Study led by Harvard researchers.

The elderly may be the exception, however. Men over age 65 who took a 50-milligram beta carotene supplement every other day during the 12-year-long study had natural killer cells that were more active than those in their counterparts who got a placebo. Natural killer cells—or NK cells—are the immune system's sentinels, ever on watch for viruses and cancer cells. They recognize an enemy immediately and destroy it, using proteins to punch holes in its outer membrane. This activity is thought to be an important component of cancer prevention. So ARS researchers tested NK cell activity in 59 men in the physicians study.

Thirty-eight were middle-aged—51 to 64 years—and 21 were elderly—65-86 years. NK cells from the middle-aged men killed cancer cells at about the same rate whether the men got beta carotene or the placebo. Among the elderly men, however, the placebo group's NK cells were significantly less active, while the supplement group's NK cells kept pace with those from the middle-age group. These results are reported in the *American Journal of Clinical Nutrition* (vol. 64, pp. 772-777). The beta carotene dosage used in the physicians study is equivalent to eating two regular-size carrots or one and one-half sweet potatoes daily.

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Low Mineral Intakes May Affect the Psyche

Rats whose laboratory diets were deficient in copper or magnesium were hyperactive and had either learning or memory deficiencies, suggesting that these two essential minerals may affect human behavior. Researchers tested the psychological impact of each mineral because previous experiments have shown that both have important roles in brain function. In one study, they fed rats diets containing either adequate copper or about one-tenth the adequate level for 10 weeks. In a second study, they altered the magnesium content of the diets in the same manner.

Deficiencies of both minerals prompted the rats to be more active in general. That's consistent with symptoms of magnesium deficiency in people who often experience tremors and disrupted sleep. The animals also turned in circles incessantly, similar to people who exhibit obsessive behaviors. The magnesium-deficient rats circled spontaneously, while the copper-deficient rats did it only after being stressed by a loud noise, the researchers reported in *Proceedings of the North Dakota Academy of Science* (vol. 50, p. 57).

The animals were also tested on their ability to learn and remember how to successfully navigate a water maze. The copper-deficient rats were slower to learn, and the magnesium-deficient animals had more difficulty remembering than their counterparts who got adequate doses of these minerals. People can easily get enough magnesium because it is found in a wide range of plant and animal foods, including green leafy vegetables, meat, fish and poultry and dried fruit. Nuts, seeds and whole grain products are good sources of both minerals. The richest source of copper is oysters.

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Food Poison Can End Up in the Joint

Some people may suffer chronic joint diseases, such as reactive arthritis, after being infected with bacterial food poisoning. ARS research has shown infections from four common food-borne pathogens—*Campylobacter, Salmonella, Shigella, or Yersinia*—can lead to reactive arthritis. A telltale sign: In reactive arthritis, the food borne organisms can't be found in joints, but antigenic components of the infecting bacteria are there.

People who have the gene for producing the human leucocyte antigen HLA-B27 are more susceptible to arthritis. While only about 2 percent of people who get food poisoning develop arthritis, about 20 percent of those who carry the HLA-B27 gene get it after being exposed. This gene is found in about 10 percent of healthy Caucasians, one percent of Japanese, and up to four percent of North American blacks, but is absent from African and Australian blacks.

Foods that carry the four common bacteria include raw and undercooked meat, poultry, eggs, shellfish and other seafood, unpasteurized milk, fruit, and vegetables. Untreated drinking water and household pets are also sources.

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Alcohol Makes Some B Vitamins Stagger

One or two alcoholic drinks a day can interfere with people's B vitamin levels, according to a study of 41 men and women. Blood levels of vitamin B_{12} dropped when the volunteers consumed 5 percent of their daily calories as alcohol. Compromising B_{12} status, over the long term, could impair memory, giving the impression of senility where there's no disease.

Most Americans get ample B_{12} because it is in animal products, including eggs and dairy foods. That's not true for folate which is supplied by dark, leafy green vegetables—such as spinach, broccoli and collards—and citrus fruits and juices. Although folate levels didn't drop with alcohol consumption, they rose significantly during the alcohol-free period. This supports other evidence that the Recommended Dietary Allowance (RDA) for folate is too low because the volunteers were given the RDA in the test diets.

Another indicator that moderate alcohol consumption interferes with vitamin B_{12} and folate was a drop in homocysteine levels during the alcohol-free period. When people don't have enough of these vitamins to metabolize homocysteine, it accumulates in the blood and damages the vessels. Elevated levels of this amino acid have recently been recognized as a risk factor for cardiovascular disease.

The findings also help to settle a long-standing debate over the cause of low B vitamins in alcoholics. Some health professionals argue that it is due to alcoholics' poor nutrition, while other attribute it to the alcohol degrading the vitamins. Both factors appear to contribute.

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Berries and Greens—A Radical Remedy?

Ounce for ounce, blueberries, Concord grape juice, strawberries, kale and spinach had the most potent antioxidant activity of 40 fruits, juices and vegetables measured in a "test tube" assay. Health professionals believe that oxygen free radicals, generated by the body's own metabolism as well as environmental pollutants, cause wear and tear on DNA and other cell parts that leads to cancer, heart disease and other diseases of aging. Eating foods that help prevent oxidative damage could enhance health and extend life. So ARS researchers measured the total antioxidant capacity of common fruits, juices and vegetables by an assay known as ORAC—for Oxygen Radical Absorbance Capacity.

Animal studies on the top-scoring foods are now in progress to see if the ability of these foods to disarm oxygen free radicals in the "test tube" translate to the human body. If so, the advice to eat more fruits and vegetables, particularly berries and greens, takes on added importance. For instance, 3.5 ounces of blueberries—about two-thirds of a cup—had the same antioxidant capacity in the ORAC assay as 1,773 International Units (IU) of vitamin E or 1,270 milligrams (mg) of vitamin C.

Blueberries, by far, had the highest antioxidant score of the tested fruits and vegetables, which were purchased at three grocery outlets in the Boston area. But scores could vary widely based on growing conditions, season and many other variables in different parts of the country. Concord grape juice had two-thirds the potency of blueberries, and strawberries were about half as potent. Among the vegetables, kale scored a little higher than strawberries, and spinach scored somewhat lower. The data are published in the *Journal of Agricultural and Food Chemistry* (fruit/vol. 44, no. 3; vegetables/vol. 44, no. 11).

The ORAC assay, reported *in Clinical Chemistry* (vol. 41, no. 12), is a unique test of total antioxidant capacity in that it measures both the degree to which a sample inhibits the action of an oxidizing agent and how long it takes to do so. The researchers are working with equipment manufacturers to develop an instrument for wide application of the assay in analyzing food, blood and other types of samples.

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Fresher Fresh-Cut Produce

Maintaining and improving the quality of fresh-cut produce is a major challenge in the fast-growing market for fresh fruits and vegetables. A chlorine solution now used by industry to control microorganism growth isn't always effective. In a joint study with Japanese scientists, ARS researchers reduced microorganism growth on cut carrots without altering firmness by dipping the carrots in a calcium chloride solution. The calcium chloride treatment also worked well on zucchini squash, which is highly perishable and very sensitive to cold temperatures.

The study also showed that fresh-cut produce should be handled and stored at or near 32 degrees F if the product is not sensitive to chilling injury. Many processors prepare, ship and store fresh-cuts at 41 degrees or even 50 degrees F.

Sales of fresh-cut produce in the United States are projected to increase from $5.8 billion in 1994 to $19 billion in 1999.

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Beans—An Untapped Medicine Chest

Winged bean, jack bean, velvet bean, snout bean, ringworm bush, and fish poison bean: These aren't exactly household names even among farmers, but they're all sources of agricultural products that could lead to future drugs. They're also part of a special legume collection maintained by USDA's Agricultural Research Service (ARS). The collection contains more than 4,000 accessions that scientists describe as an "unopened medicine chest."

Winged beans, for example, have high levels of proteins called lectins, which are used as diagnostic tools in medical research because they bind to certain blood cells. Winged beans also contain erucic acid (an antitumor medication) and polyunsaturated fatty acids that can be used to treat acne and eczema. Another legume in the collection, kudzu, is best known as a prolific but unwanted roadside weed. But it's also a source of a number of chemicals, including daidzein (an anti-inflammatory and antimicrobial agent), daidzin (a cancer preventive) and genistein (an antileukemic agent).

Velvet bean is a source of dopa, which the brain converts into the neurotransmitter dopamine. Reductions in dopamine have been associated with Parkinson's disease, which occurs when dopamine-producing brain cells are destroyed. Velvet bean also contains serotonin, another brain neurotransmitter that may be involved in learning, sleep, and control of moods.

Along with their pharmaceutical potential, these legumes also "fix" nitrogen, transforming atmospheric nitrogen into a form plants can use for growth and enriching the soil, which makes them ideal for sustainable agriculture. Some legumes can add up to 500 kilograms of nitrogen per hectare to the soil, alleviating the need for fertilizer and lessening the chance of water pollution.

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Soy Oil With A Heart?

Saturated fat content is only about 7 percent in seeds of two new soybean breeding lines—less than half the typical 16 percent found in soybean oil. The Food and Drug Administration allows a product to be labeled "low in saturated fat" if it contains no more than one gram per serving. To meet that standard, soybeans must contain no more than 7 percent saturated fat. The new lines were bred to contain less palmitic acid—a saturated fat shown to raise LDL cholesterol levels in the blood—and more oleic acid, which has some health benefits.

Soybean oil is found in more than 75 percent of the vegetable oils and fats now on the market. One line, developed in North Carolina, is late-maturing and suited for southeastern breeders. The other, developed in Indiana, matures a little earlier to meet the needs of Midwestern breeders.

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Almost All-Fruit

Consumers, confectioners and fruit growers could benefit from novel fruit products developed by ARS scientists. Researchers made molded, restructured fruit pieces containing up to 30 percent apricot or peach puree. Another method—known as twin-screw extrusion—produced licorice-like ropes containing up to 100 percent fruit.

Many commercial snacks containing fruit include much more sugar than these pieces and use less than 5 percent juice or puree. The higher fruit content of these products could make them a more healthful addition to confections and baked goods. Restructured fruit products could also expand the market for soft fruits that can be pureed during the growing season and used by manufacturers year-round. New combinations of starch and gelatin allow the puree to be custom-manufactured into a wide range of products.

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